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Magnesium chlorate by electrolysis of magnesium chloride

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Studies concerning the electrochemical preparation of magnesium chlorate were made and the effect of various operating parameters on the precipitation of magnesium hydroxide during electrolysis of magnesium chloride solution is discussed.

INTRODUCTION

The chlorates of alkali metals were studied extensively [1,2] and work on electrochemical methods for preparing alkaline earth metal chlorates are scarce, even though their salts have some speciality applications [3]. The difficulty in electrolysis of the alkaline earth metal chlorides is mainly due to the precipitation of the corresponding metal hydroxides. In the earlier paper, some parametric effects on the current efficiency for the formation of magnesium chlorate were presented [3]. The effect of these parameters on the precipitation of hydroxide is discussed in the present communication.

EXPERIMENTAL

The electrolytic cell consisted of metal anode of the RuO_2-type and a rotating stainless steel cathode. The experimental arrangement and the details of the electrolysis were reported earlier [3]. During each experiment, the loss of Mg^{++} as hydroxide was estimated.

RESULTS AND DISCUSSION

The effect of various operating parameters on the chlorate current efficiency and the loss of Mg^{++} as hydroxide are presented in Figs. 1 to 4. It has been found that the magnesium hydroxide separation is (i) increased with increasing concentration of magnesium chloride in the electrolyte (ii) minimum at pH around 6.0 (iii) decreased with decreasing cathode current density and (iv) decreased with increasing cathode rotation.

The above observations can be explained on the basis of the change in cathode surface pH with the different parameters studied. Although the bulk pH is in the acidic side (4-7), cathode surface pH is likely to be more alkaline (8-13) depending on the mass transfer conditions. According to Pourbaix diagram [4] the magnesium hydroxide forms adherent coating over the cathode in the pH range of 8.5 to 11.5. Because of this, in some experiments, even though the cathode current density, concentration and pH were optimum, low cathode rotation gave less efficiencies and high cell voltages. At pH above 6.5 and at high cathode current densities, the reaction proceeded well, but the precipitation was more. This may be due to the continuous removal of the magnesium hydroxide scales from the cathode surface which happens above pH 11.5 [4]. The optimum concentration of magnesium chloride was about 2M. Above and below this concentration, more of hydroxide separation occurred, probably due to the availability od higher Mg^{++} at the cathode in the former, while increased water discharge due to dilution enhanced OH^- concentration in the latter.

CONCLUSION

Experimental evidences indicate that magnesium chlorate can be effectively produced under optimum conditions with a rotating cathode.

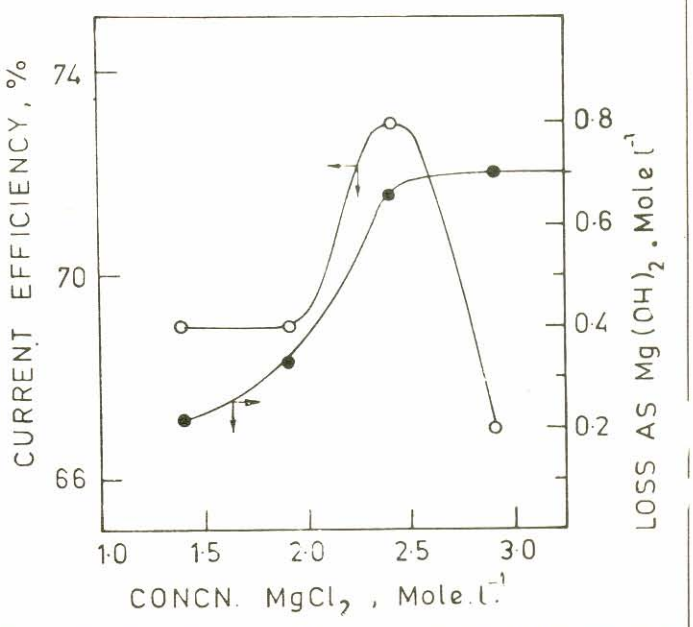

Fig. 1: Variation of current efficiency and loss of $Mg(OH)_2$ with concentraction of $MgCl_2$

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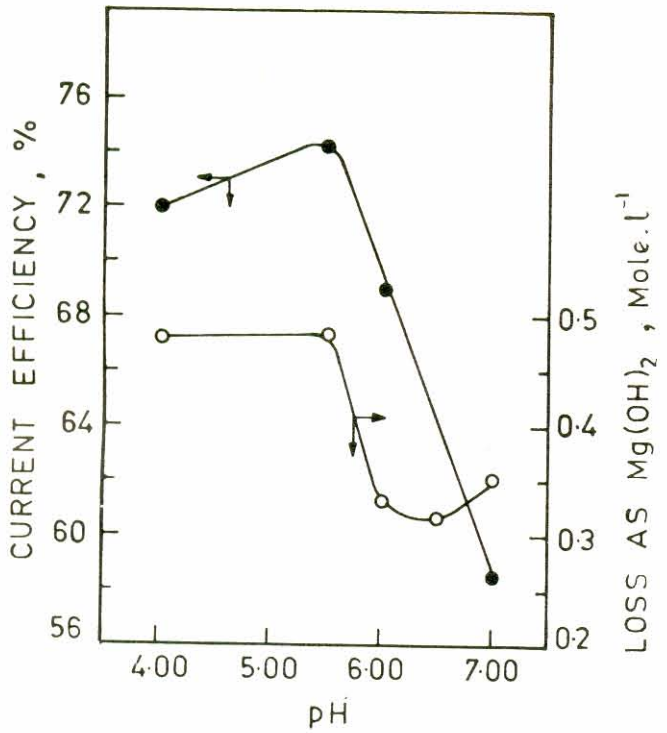

Fig. 2: Variation of current efficiency and loss of $Mg(OH)_2$ with pH

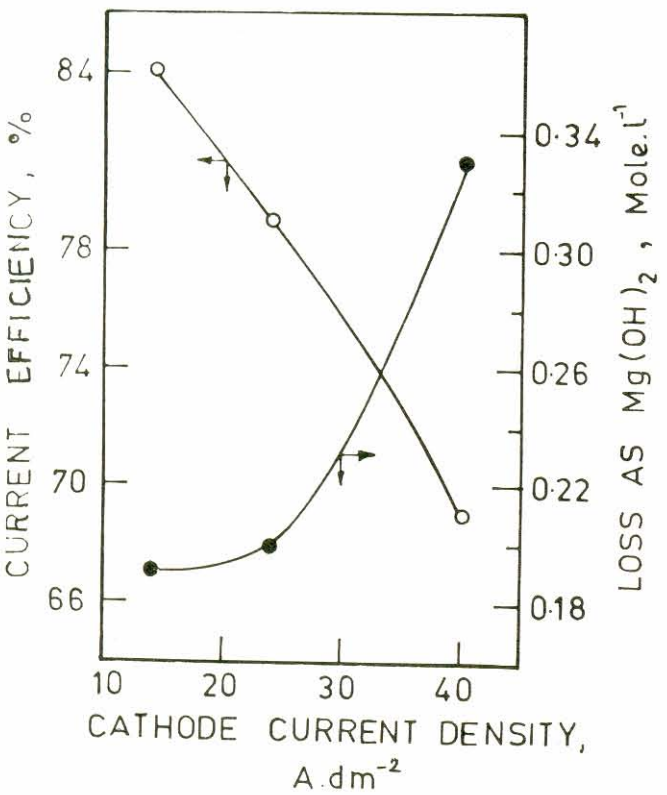

Fig. 3: Variation of current efficiency and loss of $Mg(OH)_2$ with cathode current density

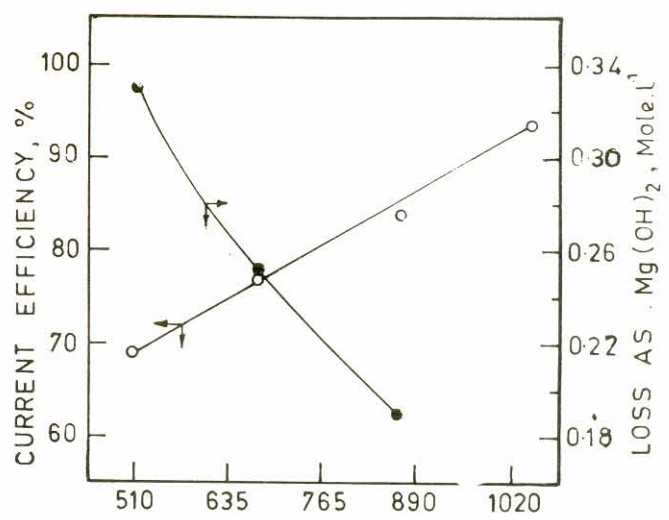

Fig. 4: Variation of current efficiency and loss of $Mg(OH)_2$ with cathode rotation

REFERENCES

1. N Ibl and H Vogt in *Comprehensive Treatise of Electrochemistry*, (Ed) J O'M Bockris, B E Conway, E Yeager and R E White, Vol **2**, Plenum Press, N.Y. (1981) p 208

2. S Pushpavanam, M Sadagopalan and K C Narasimham, *Trans SAEST*, **20** (1985) 215

3. S Pushpavanam, S Mohan, S Vasudevan, S Ravichandran, K C Narasimham and K I Vasu, *Bull Electrochem*, **5** (1989) 364

4. J VanMuylder and M Pourbaix in *Atlas of Electrochemical Equilibria in Aqueous Solutions*, (Ed) Pourbaix, Pergamon Press, N.Y. (1966) p 141